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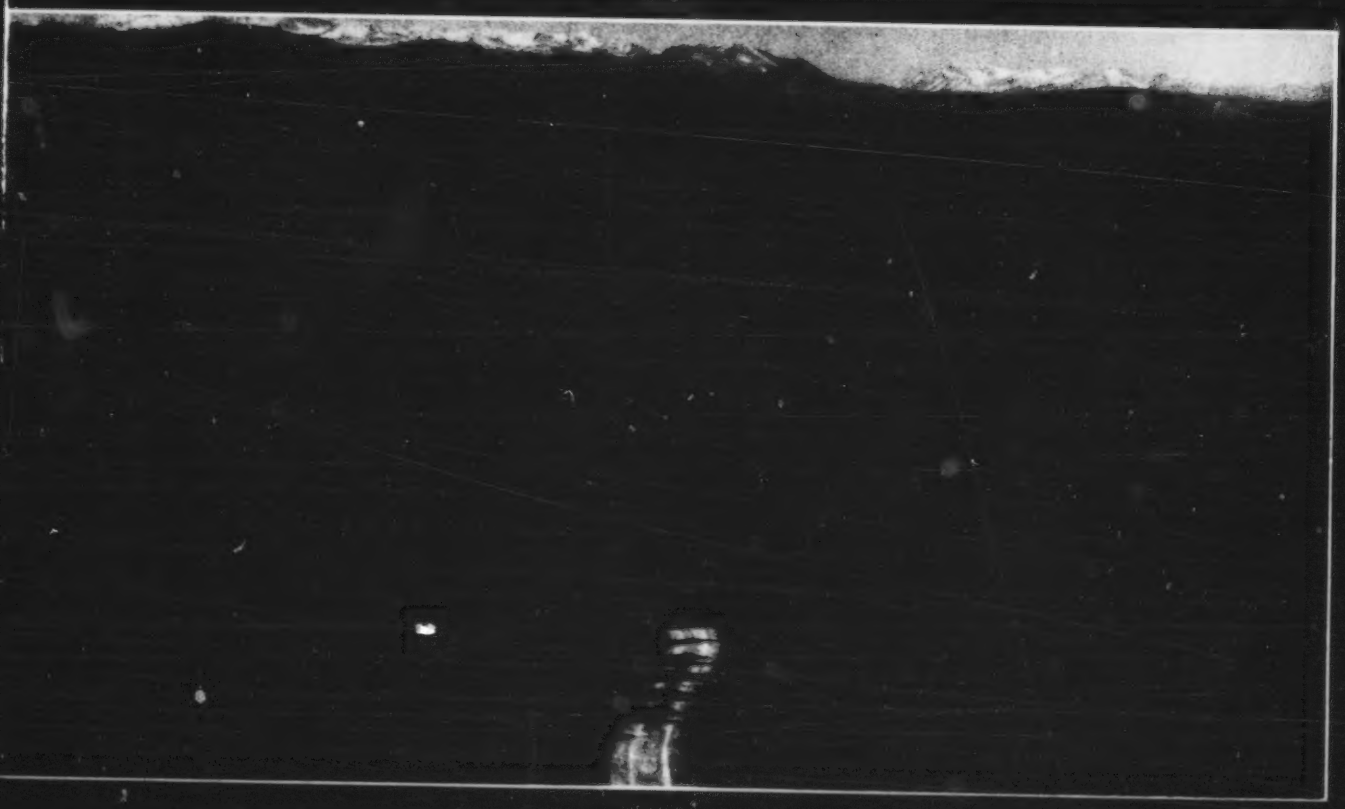
Mountain Pine Beetle Control Program 1980-1986



Alberta

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SUMMARY

Although the mountain pine beetle has been detected in Alberta's forests in the past, the most recent outbreak beginning in 1977 is the first significant infestation which has threatened the major forest stands established along the Eastern Slopes.

A control program was initiated in 1980 with the objective to contain the northward spread of beetles until the natural factors reduced the population to an acceptable level. Continuous, intensive and thorough treatment activities, aided by the natural forest/prairie boundary and climatic conditions, have successfully arrested the spread of the beetles outside the major outbreak area. Recent indications of declining beetle population would suggest that the current outbreak is ending. This program, therefore, has attained its objective and can be considered one of the few successful mountain pine beetle control programs recorded in North America.

INTRODUCTION

Mountain pine beetle outbreaks have been reported periodically in western North America since 1909. In recent years, these outbreaks became more significant as the beetle began threatening the forest industries located in the increasingly valuable pine stands. The adult mountain pine beetle (Figure 1) grows no larger than 5 to 7 mm (about ¼") in length, but its impact on living lodgepole pine trees can be devastating. This beetle has, no doubt, always co-existed with the lodgepole pine.

In Alberta, most of the lodgepole pine stands grow along the Eastern Slopes of the Rockies, from the United States border to the Peace River. This region contains major forest industries which rely on lodgepole pine. Extensive recreation areas such as Kananaskis Country and Banff and Jasper national parks (Map 1) constitute a significant portion of this region. Thus when the first beetle infestation in Alberta was reported in 1977, there were justified apprehensions. Although only limited action to counteract the beetle was taken initially, the indicated northward advance of the beetle required an immediate and comprehensive control program. This program was implemented in 1980 and was to continue until the beetle population no longer threatened the protected forests.

Figure 1

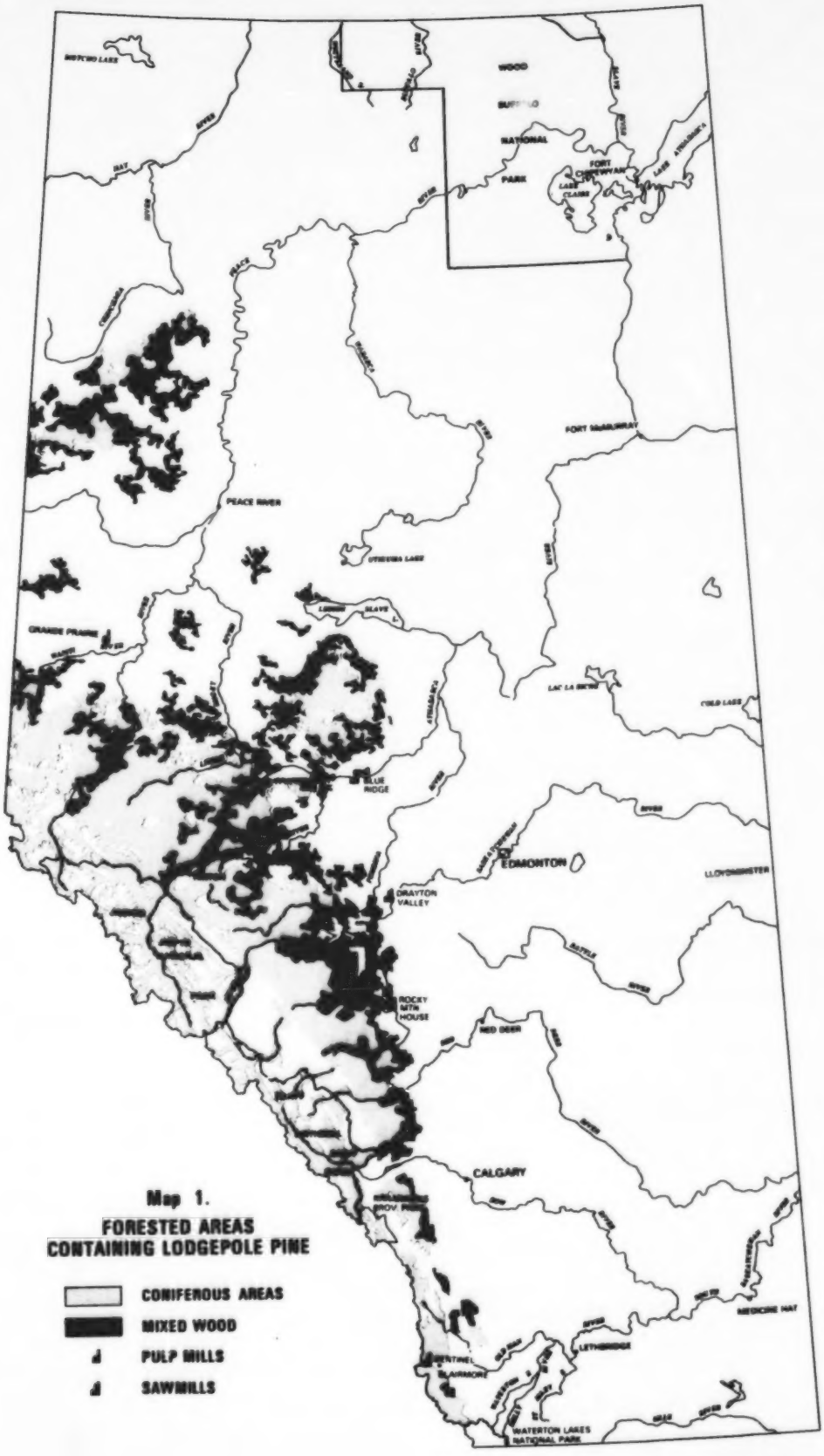
OBJECTIVE

The objective of this control program was to prevent the beetles from spreading and endangering the extensive lodgepole pine stands in Alberta. The control program was organized by the Alberta Forest Service because it is their responsibility to manage and protect these stands.

HISTORY OF THE OUTBREAK

In the early 1970s a mountain pine beetle outbreak was noticed in Glacier National Park in Montana. This outbreak expanded northward rapidly up the Flathead River and was found in British Columbia by 1975. In 1977 numerous small infested spots of lodgepole pine were discovered in Waterton Lakes National Park and in the adjoining Castle River Valley area (Map 2.). Beetle presence had been recorded in this area previously, but not in recent years. Beetle traps located in the mountain passes between Alberta and British Columbia indicated that the beetle was flying eastward into Alberta, which led the Alberta Forest Service to believe that there was a migration from the outbreaks outside the province.

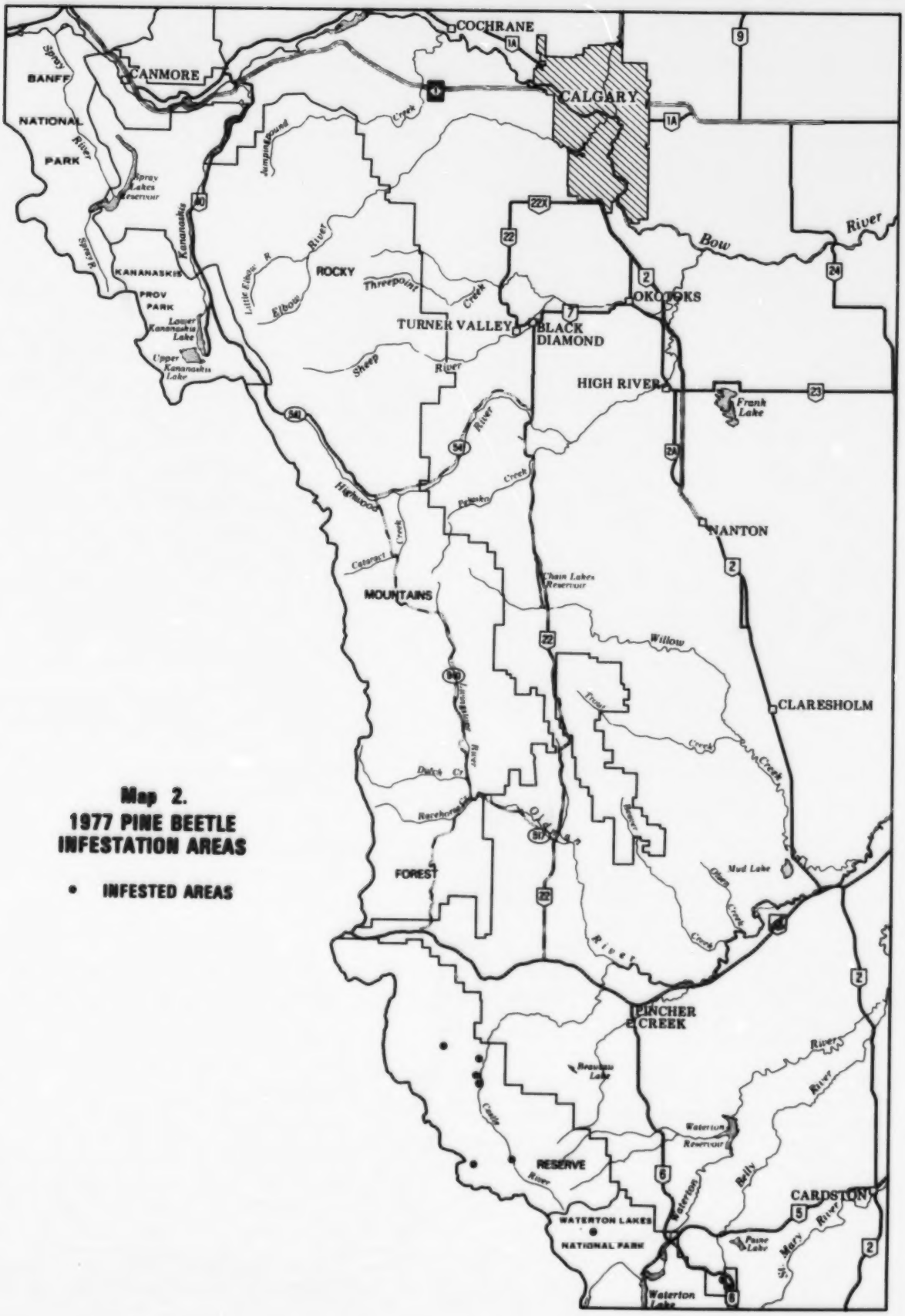
Initial action on the beetle was limited to removing infested trees from campgrounds. Because this region was rated as a low beetle outbreak hazard area based on climate, periodic extreme cold spells were expected to prevent the expansion of the outbreak. However, the exceptionally mild winters in 1978 and 1979 allowed the beetle population to expand very rapidly. Thus by 1980 the infestation had spread over 7750 ha, mostly in the Waterton Lakes National Park and in the adjacent Castle River Valley area (Map 3). Surveys indicated that there were also spots of infestation throughout the Porcupine Hills and the Cypress Hills. This northward spread of the beetle greatly concerned the Alberta Forest Service and led to the recommendation of a control program.

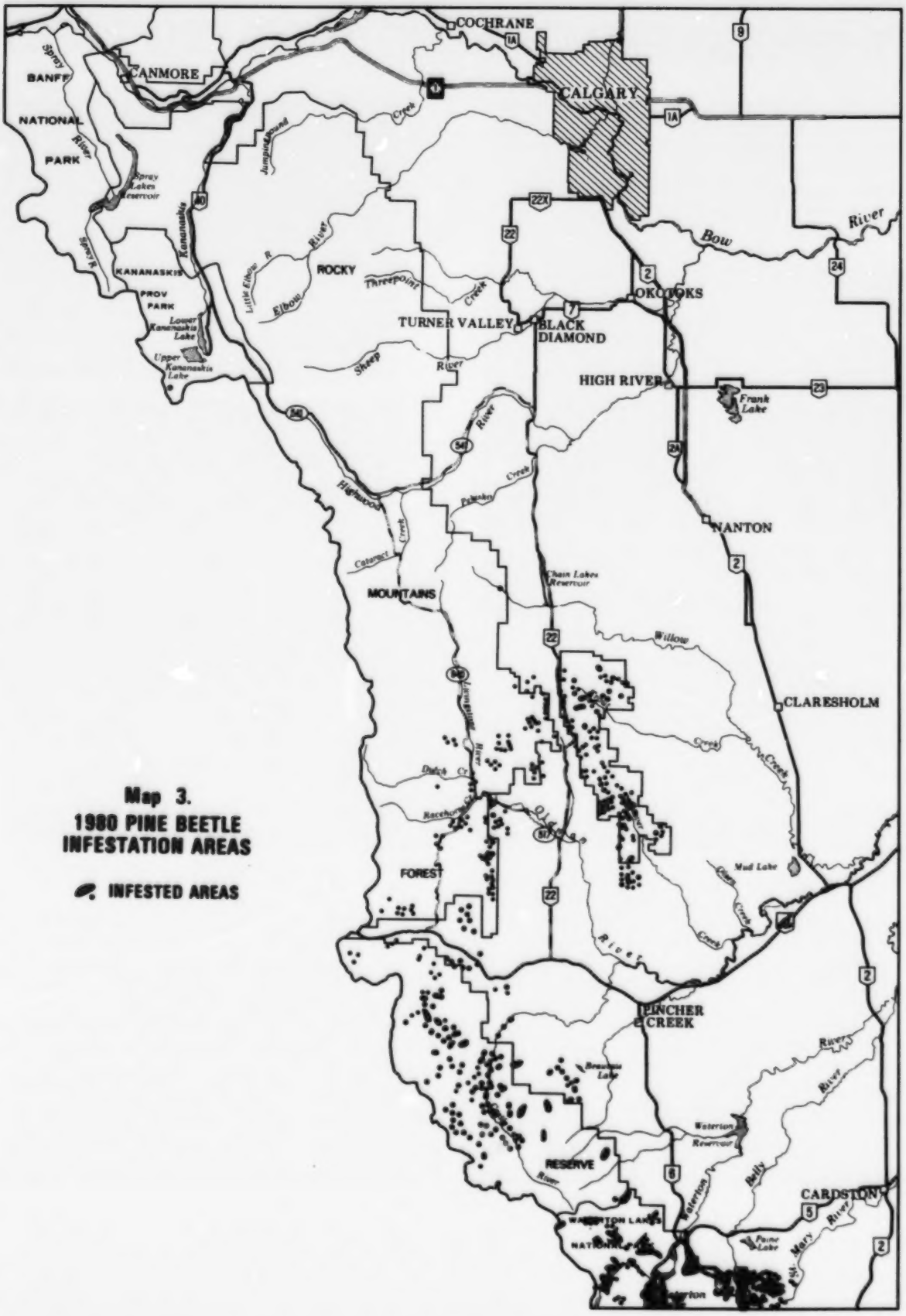


Map 1.

FORESTED AREAS CONTAINING LODGEPOLE PINE

- CONIFEROUS AREAS
- MIXED WOOD
- PULP MILLS
- SAWMILLS


COCHRANE
CANMORE
BANFF
NATIONAL PARK
CALGARY
Spray Lakes Reservoir
Kananaskis
KANANASKIS PROV PARK
Lower Kananaskis Lake
Upper Kananaskis Lake
ROCKY
Elbow River
Threepoint Creek
TURNER VALLEY
BLACK DIAMOND
OKOTOKS
Bow River
HIGH RIVER
Frank Lake
NANTON
Highwood River
Cataract Creek
MOUNTAINS
Chain Lakes Reservoir
Willow Creek
CLARESHOLM
FOREST
Mud Lake
PINCHER CREEK
Waterton Reservoir
RESERVE
CARDSTON
WATERTON LAKES NATIONAL PARK
Waterton Lake
Belly River
St. Mary River
Map 2.
1977 PINE BEETLE INFESTATION AREAS
• INFESTED AREAS



Map 3.
1980 PINE BEETLE INFESTATION AREAS

INFESTED AREAS

THE PROBLEM

The beetle lives most of its life beneath the bark of the tree. It prefers to attack older trees (60 years+) as the thicker bark and phloem provide more food and better protection. In July the adult beetles bore into the trees and tunnel a vertical gallery where they mate and the females lay up to 80 eggs (Figure 2). These eggs hatch into larvae

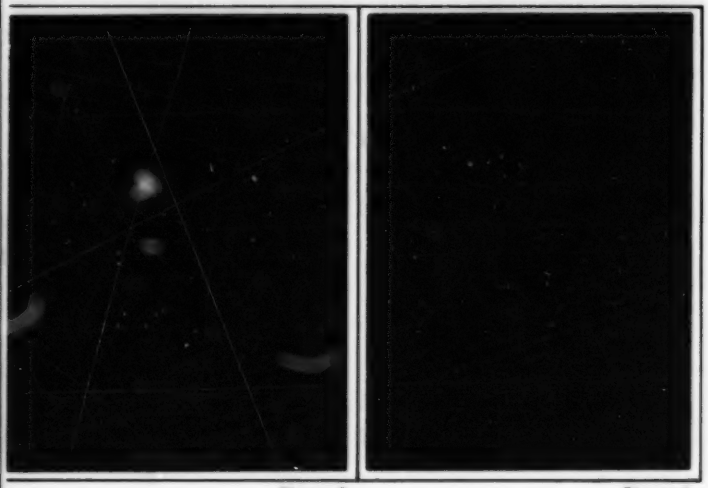


Figure 2 *Figure 3*

within two weeks. The larvae then begin to tunnel horizontal galleries (Figure 3), and at the same time go through several growing stages called instars. Development of the beetle is not complete until the next summer, since the larvae overwinter beneath the bark. Protected by the bark and the larva's internal "anti-freeze", the larva can easily survive the winter as long as there are no unseasonably cold temperatures or prolonged cold spells (-30 to -35°C). In the spring the larvae become active again as the temperature rises. When the larvae mature in late June, they construct an oval-shaped chamber (Figure 4) where they remain dormant (pupate) and develop into adults. From mid July to mid August the new adults bore through the bark and fly to attack new trees.

Figure 4

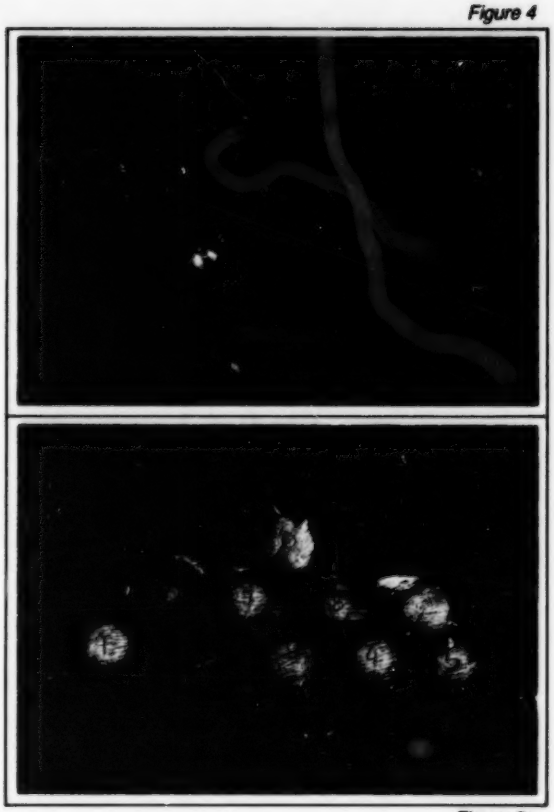


Figure 5a

The trees are killed by a combination of beetles and fungi. When the adult beetle builds galleries in the living cells of the lower stem of the tree, the transportation of the nutrients (sap) to the upper stem, branches and needles is halted. Secondly, when the beetle successfully attacks a tree, it introduces a blue stain fungus (Figure 5a) which kills living cells, thus further reducing the transportation of this sap.

Enemies of the beetle include woodpeckers, parasites and predatory insects. At low beetle population these organisms help to keep the population in check, but with a major outbreak these natural biological controls do not appear to limit the population explosion. Normally a major weather change such as a prolonged unseasonable cold spell or the lack of a food source ends the outbreaks.

SIGNS AND SYMPTOMS OF INFESTATION

The normal reaction of an attacked tree is to attempt to isolate and drown the intruding beetle with a thick sticky fluid called pitch. This pitch forms pitch tubes (Figure 5b) which show on the surface of the bark of the tree. This is one means of detecting an attacked tree. Another method of ground detection is to watch for brown sawdust at the base of the tree caused by the boring of the beetle. As the tree dies the foliage of the pine fades to a yellow color (Figure 6) then to a bright red (Figures 7 and 8). When the needles fall from the tree the stand usually appears to be grey (Figure 9). This discoloration of the needles is used in aerial detection to map and survey an infestation.

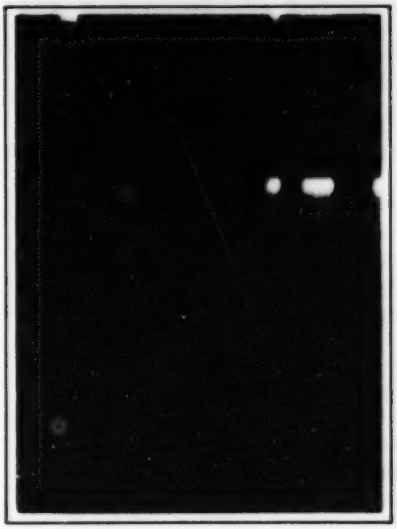


Figure 5b

Figure 6

Figure 7

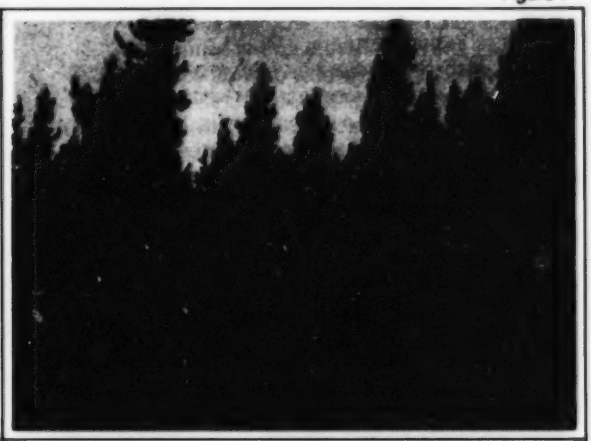


Figure 8

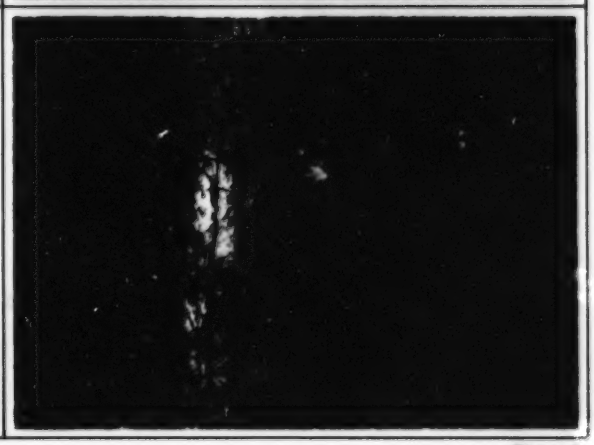


Figure 9

CONTROL PROGRAM

Approval to implement a full-scale mountain pine beetle control program was given in April 1980, and planning began immediately.

1. Overview

The infested areas were divided into a control and salvage zone. The salvage zone included all areas where the outbreak was already too severe for any effective action. The control zone initially included all lodgepole pine stands north of the Crowsnest Highway (Highway #3) but later was expanded to include the Blairmore Ridge on the south side of this highway (Map 4).

The first aerial surveys of the control area indicated only about 150 spots requiring treatment. However as aerial and ground surveys continued, the number of spots requiring treatment increased tenfold. As the control action appeared to be more complex than originally thought, a former Canadian Forestry Service insect and disease survey specialist (Gordon Smith) was engaged to look after the program.

At the initial stages of the program, only a small number of workers were hired to detect and dispose of the infested trees. However, by the end of 1980 the number of trees requiring treatment increased so dramatically that a camp had to be organized to accommodate all the needed personnel. At the peak control period in 1981, 61 people were involved with the beetle program. The number of workers required began to decline by 1983 as the number of lodgepole pine trees requiring treatment diminished to less than 10 000 per year (Table 1).

Discovery of a few infested trees in the Kananaskis Country in 1982 required an increased monitoring and control program for this area. There was a fear that beetle activity to the west of this area in British Columbia would spill over and create a major outbreak. Fortunately, however, this did not occur and the infestation in this area remained at an easily controllable level.

In 1984, the limber pines growing in the higher elevations of the control zone just north of Blairmore were found to be infested by the beetles. Limber pines are scrubby trees which have little economic value except for providing some shelter for cattle and protection to watershed. Buildup of infestation in limber pine occurred very quickly, so when control action was taken there were already over 30 000 trees affected. Since a large percentage of infested trees were on the eastern outskirts adjoining the prairies, action was limited to the areas within the Crown land in the Porcupine Hills and all the area west of these hills. This action was taken only because of the possible threat to the lodgepole pine stands which already were sanitized.

Surveys taken in 1985 throughout the infested areas revealed that the total beetle population appeared to be declining. The early cold snap in October of 1984, followed by severe cold spells in December and February, may have contributed to an increased mortality of the beetle larvae. A major control program is no longer required with this apparent decline and containment of the beetle population. A monitoring program continues to ensure that a major outbreak will not recur.

The total cost of this program exceeded $6.2 million over the six-year period (Table 2). If the total cost is spread over the areas of the high hazard lodgepole pine stands adjacent to the salvage zone, the cost averages $32 per hectare per year. On the other hand, if this total cost was spread over the 2 350 000 ha of lodgepole pine along the Eastern Slopes, the cost for protection would be only $0.44 per hectare. This is a minimal cost for protecting a resource which is the basis of many forest industries.

2. The Detection and Survey Strategy

The detection procedure required two steps. The first was to locate the infested areas from the air. Using the tree color changes, infested spots were surveyed from the air and marked on a map. Helicopters were used extensively for this purpose. The second stage was to ground truth the infested spots, and identify and flag all infested trees that required treatment. To ensure that infested trees were not missed, ground surveys of the area were initiated using a "line sweep" system. This system involved six to eight people advancing abreast (approximately 25 m apart) through the infested and surrounding areas. As the control program progressed and the number of visibly faded trees declined, other means for locating new infestations had to be used. One method used was to visit areas surrounding previous treatments. Beetles appeared to be attracted to areas where treatment had already occurred.

Pheromones have been used, in recent years, to aid in the survey, detection and monitoring processes. Pheromones are natural substances which give off odors and are used by the beetle in a complicated communication system to locate and colonize susceptible trees. Pheromones produced by the beetle, combined with the natural tree odor, are a powerful force which aids in sustaining an outbreak. Synthetic pheromones can be manufactured and used to simulate the natural odors. A combination of

three chemicals is required. These chemicals are placed in vials and packaged in a container which is either placed in a funnel trap (Figure 10) or attached directly to a trap tree (Figure 11).

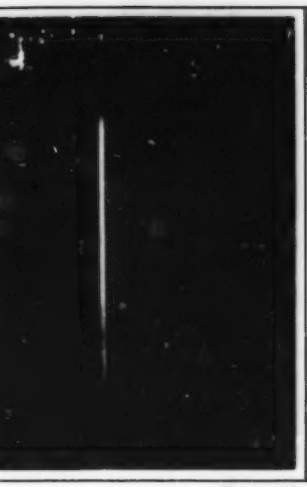


Figure 10

Figure 11

The first experimental trials using pheromones in Alberta were in 1980. These initial trials proved inconclusive since the chemicals used did not consistently attract the beetle. In 1982, the University of Calgary and the Canadian Forestry Service began a joint study to evaluate several different chemicals. This research program was funded by the Alberta Forest Development Research Trust Fund, the Alberta Forest Service and the Canadian Forestry Service. A commercially available pheromone and a number of chemicals produced at the University of Calgary were field tested. The result of this study indicated that some of these new chemicals were much more effective than those used in the initial trials. In 1983 the most effective pheromone chemicals were used operationally for the first time as a tool in the survey program. There is no doubt that the use of pheromones will be continued in future monitoring programs.

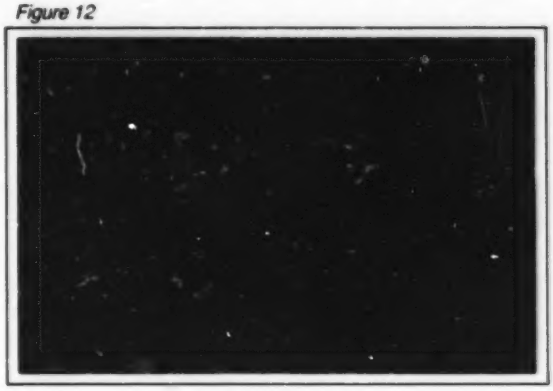
3. The Treatment Process

Because the mountain pine beetles live most of their lives beneath the bark, control action is difficult and choices are limited. Effective chemical control methods for large-scale application have yet to be found. Biological control is still in the research and experimental stages, thus the only alternative available was to fell every infested tree and destroy the beetle's habitat. Where concentration of infested trees existed close to road access, the first option was to salvage the trees and ensure utilization before beetle flight. In areas where concentration did not occur and/or easy access was not available the trees were treated by debarking and/or burning the trees. This method was used in a two-pronged action to reduce the beetle population, and hence limit the spread of the infestation.

Firstly, the beetle population was reduced in the salvage zone by logging the infested stands, sawing the logs into lumber, and burning or chipping the bark and other wastes before the beetle flight. In this way the infested trees were salvaged and at the same time the number of new beetles available to fly into the control zone was decreased. Movement of all infested trees was also halted during the critical beetle flight period. This was accomplished by placing a moratorium on the hauling of unpeeled wood products within the infested area as well as from other provinces.

Secondly, in the control zones, the trees were treated in a number of ways. Where access allowed, the infested trees were sanitized in a similar manner to those in the salvage zone. In areas where access was limited, trees were treated on site by felling and sawing into short logs and then burning or debarking them (Figure 12). In areas where burning was limited because of fire hazard, the infested trees were hauled with helicopters to a treatment site (Figure 13).

Figure 12



The beetle control methods used by the Alberta Forest Service were not new. These procedures had been tried by other agencies but apparently failed due to lack of persistent follow-up action. There were two advantages which probably made the Alberta program successful. The first was that most of the beetles moved into the province from one front. This simplified the control program as the majority of the action could be dedicated to one area. The other advantage was that prevailing winds in the infested area blow from the west and southwest. Since the forest zone is due north of the major outbreak, a large number of the beetles carried by the wind probably landed in the non-forested area. However, without the control program the pines in the Porcupine Hills and the East Livingstone Range would have been decimated and no doubt the beetles would have moved farther north.

Figure 13

Control Program

Table 1

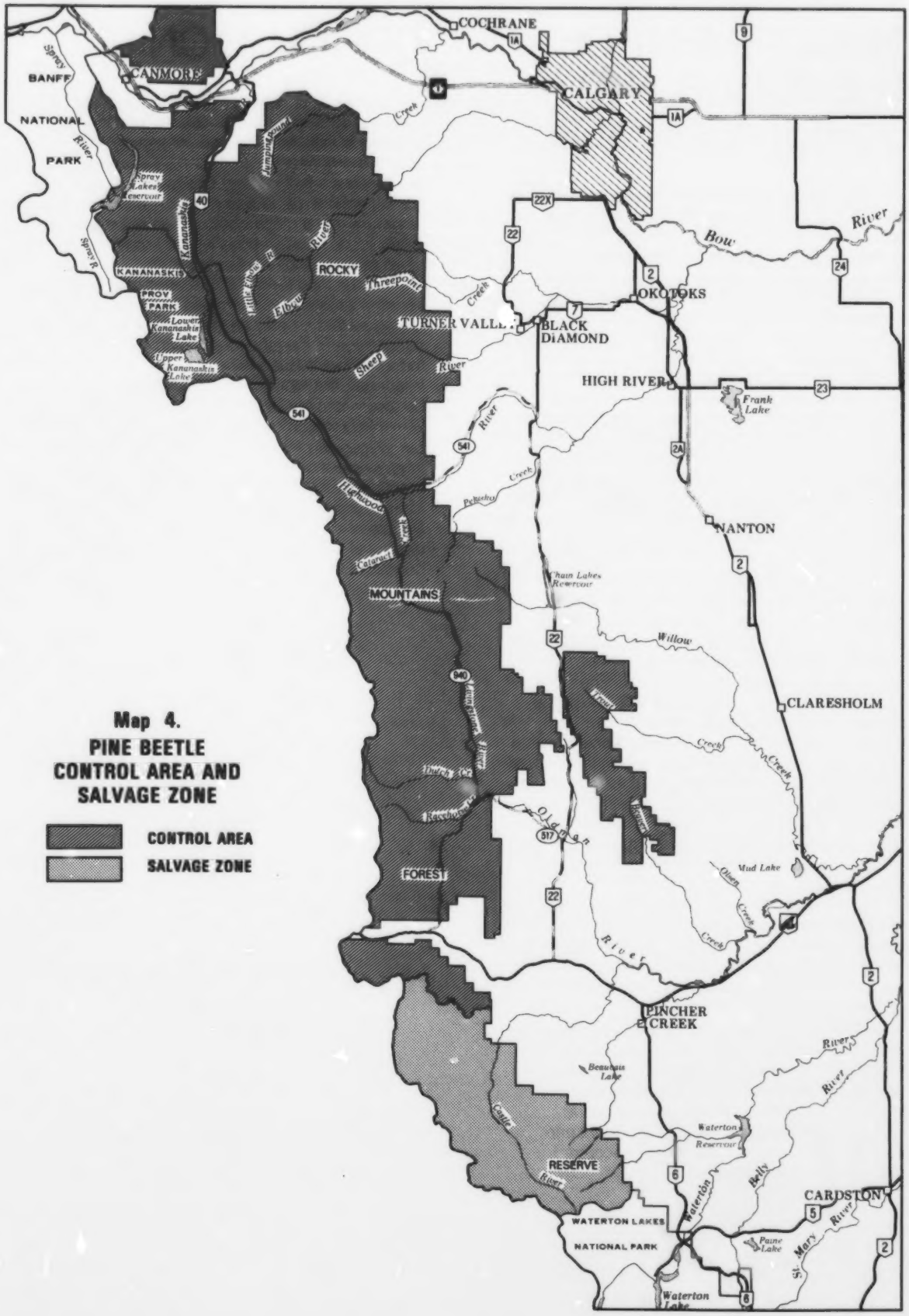
TREES TREATED IN CONTROL PROGRAM

Beetle Development year	Number of Trees treated	
August - July	Lodgepole pines	Limber pines
1979 - 1980	15 689	
1980 - 1981	24 702	
1981 - 1982	7 222	
1982 - 1983	7 990	
1983 - 1984	8 792	23 250
1984 - 1985	5 030	13 704

Table 2

ANNUAL EXPENDITURE FOR THE FOREST INSECT AND DISEASE PROGRAM

Fiscal Year	Expenditure
	$
1980 - 1981	1 312 149
1981 - 1982	1 926 477
1982 - 1983	618 514
1983 - 1984	1 123 915
1984 - 1985	1 176 364


COCHRANE
CANMORE
CALGARY
BANFF
NATIONAL
PARK
Spray
River
Spray Lakes Reservoir
Kananaskis
Jumpingpound
Fisher
Little Elbow
Elbow
ROCKY
Threepoint
Creek
KANANASKIS
PROV. PARK
Lower Kananaskis Lake
Upper Kananaskis Lake
TURNER VALLEY
BLACK DIAMOND
OKOTOKS
Bow
River
HIGH RIVER
Frank Lake
Sheep
River
Highwood
Pekisko
Creek
NANTON
Chain Lakes Reservoir
Willow
Creek
CLARESHOLM
MOUNTAINS
Livingstone
Beaver Mines Lake
FOREST
Mud Lake
Oldman
River
PINCHER CREEK
Beauvais Lake
Castle
RESERVE
Waterton Reservoir
Waterton
Belly
River
CARDSTON
WATERTON LAKES
NATIONAL PARK
Paine Lake
St. Mary
River
Waterton Lake
Map 4.
PINE BEETLE
CONTROL AREA AND
SALVAGE ZONE
CONTROL AREA
SALVAGE ZONE

INVOLVEMENT OF THE PUBLIC AND OTHER AGENCIES

Numerous public meetings were held to enable the public to gain a better understanding of the problem and the program. Meetings were held with the media, special interest groups, local government officials as well as the general public. A special symposium hosted jointly by the Alberta Forest Service, the Canadian Forestry Service and the Canadian Institute of Forestry was held in Coleman. Pamphlets and signs were also produced to explain the problem. The general public is to be commended for their interest and awareness of this program.

As private landholdings were included as part of the control zone, co-operation of the landowners was requested and received. The Alberta Forest Service acknowledges this co-operation, without which the control program may not have succeeded. The Alberta Forest Service also acknowledges the involvement of Alberta Transportation during the log hauling moratorium period.

Since the beetle appeared to spread across interagency borders, the Mountain Pine Beetle Interagency Committee was formed with senior executives representing the Alberta and B.C. Forest Services, Parks Canada, and the Northern and Pacific Forest Research Centres. This committee was formed at Alberta's initiative with the prime objective of obtaining commitments from neighboring agencies to take specific initial action in localized areas, where beetle populations could eventually threaten to expand to Alberta's forests. Parks Canada in particular took effective action on specific infestations in Kootenay and Banff national parks. A working subcommittee organized under the senior group with representatives from all the above named agencies, plus the B.C. Provincial Parks, met annually or semi-annually to exchange views and recommend actions as necessary. This subcommittee served its purpose, as communication among the agencies was vastly improved, which resulted in better understanding of each other's problems and desires.

In November 1981, a joint U.S./Canada meeting was held to review the mountain pine beetle problems. This meeting resulted in the signing of an International Agreement and a Memorandum of Understanding for co-operative action on the mountain pine beetle problems. Field tours and information exchanges have already occurred among the involved agencies.

CONCLUSION

The result of Alberta's mountain pine beetle control program speaks for itself — under proper conditions with intensive and persistent treatment activities a control program can be successful.

Since a small number of beetles are still in the control zone a monitoring program will be continued to ensure that a major outbreak will not recur. Any newly found infested trees will be treated under a small maintenance control program.

For the long term, the mountain pine beetle has certainly created the increased awareness that biological factors play an important role in the natural succession of the pine forest. Although Alberta is fortunate that these problems have not occurred frequently, the Alberta Forest Service must constantly be aware that this kind of problem can happen again. To minimize such occurrences, better management of our lodgepole pine stands is absolutely essential. Improvement of these stands by good silvicultural practices would certainly reduce the chances of the trees being prematurely lost by a beetle outbreak. People and not the beetle can then control the destiny of these stands. This will not only be beneficial to the forest industries but aid in the maintenance of a healthy forest for the future.